Application Guide of Temperature Measurement and Control

Temperature Measurement And Control

NTC thermistor is especially fit for using as temperature sensors because of its high delicacy. The cost of sensors is feasible in the range of temperature from –55℃ to +300℃.

Select the NTC thermistor according to the following dependent connection：

-The required range of temperature
-The required range of resistance
-The required measuring precision
-Environment (medium)
-The expected time coefficient
-The demands of geometrical dimensions

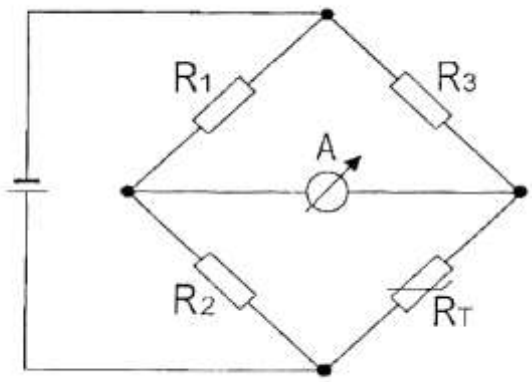

Chart 1 Wheatstone Bridge Circuitry

A feasible circuitry used in temperature measurement with NTC thermistor could be make up of a Wheatstone Bridge in which a NTC thermistor hitches on a bridge arm.

If the sensor temperature changes in the balanceable bridge circuitry, a remarkable current will pass through the amperometer. Sometimes, a variable resistance R_3 would be used, according to the resistance of which we can deduce the temperature (In the balanceable state).

Also, NTC thermistors and sensors are always in connection with relays or magnetic amplifier loop of relevant signal and protection equipments, and fitted in the place where needs temperature control. When the temperature changes, the resistance of NTC thermistor will also change, which will cause the bridge circuitry balance lost and that there is current passing through the relays and the relays controls the current, so the temperature in the control place will be adjusted.

Linearization of NTC Thermistor Characteristic Curve

The resistance change of NTC thermistor is remarkable illinear. If we need a nearly linear change while measuring a larger range of temperature, such as used in a dial, a resistance is in series or in parallel connection will bring us a good linearity. Except that the range of temperature exceeds 50 to 100K.

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(a) (b)

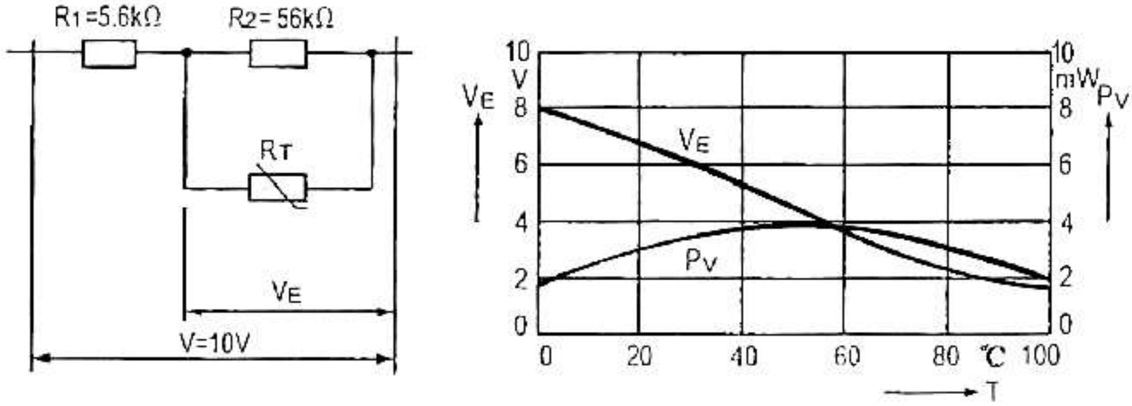

Chart 2 (a) Linearization of NTC thermistor by a resistance in parallel connection (b) Signal voltage V_e and consumption power P_v on the linearized NTC thermistor

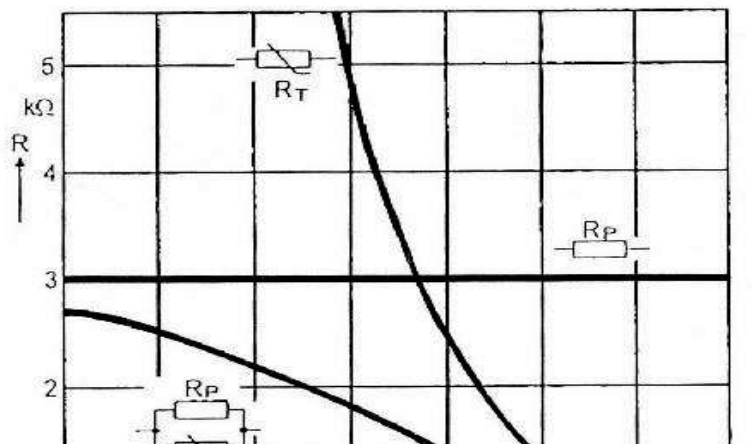

Chart 3 The R-t curve of linearization by resistance in parallel connection

A combination of NTC thermistor and a resistance in parallel connections will have a *S* shape characteristic curve. The best linearization will be gained if the inflexion is placed in the middle of the operating temperature. In this conditions, the resistance in parallel connection can be approximately calculated by applied exponential：

$$R_P = R_{TM} \frac{B - 2T_M}{B + 2T_M}$$

The resistance of R_T ,R_P which are in parallel connection is:

$$R = \frac{R_P \bullet R_T}{R_P + R_T}$$

In the equation：
R_{TM} is the NTC thermistor resistance at average temperature of TM
(Unit K: ≌temperature℃+273.15)
B is the B value of NTC thermistor
(linear) slope of the characteristic curve:

$$\frac{dR}{dT} = \frac{R_t}{[1+\frac{R_T}{R_P}]^2} \bullet \frac{B}{T^2}$$

Delicacy of linearizated NTC thermistor circuitry must decline.

(a) (b)

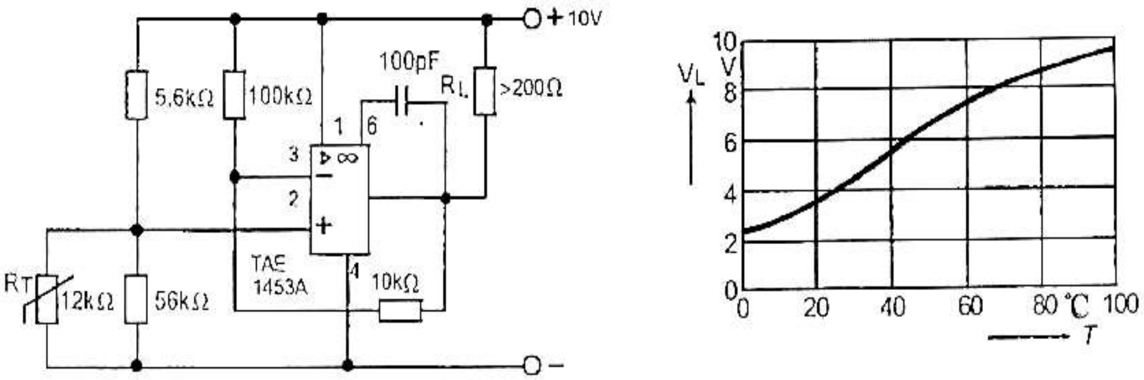

Chart 4 Characteristic curve linearization of NTC thermistor

(a) The realized simple amplifier circuitry

(b) The output voltage at the spot of laden resistor as the function of temperature

Illumination Proceeding

There are following characteristics compared NTC thermistor and sensor with other sensors in temperature measurement and control:

1. Steady and security performance;
2. High precision, Good quality of coherence and interchange;
3. Large temperature coefficient of resistance, High delicacy;
4. Low cost, especially for middle-or-low temperature measurement and control
5. High-dissipation manufactures capable, Test current can be far larger than that of traditional structure sensors, simplify the circuit.

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